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Self-Decontaminating CARC Technology



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Company Overview

Inovatia Laboratories, LLC is an independent contract research organization (CRO) providing research, analysis, consultation, and technology development services to public and private entities throughout North America.

The company's core competencies lie within the field of analytical chemistry and its related materials and instrumentation.





Introduction

No single technology can meet all decontamination requirements. Rather, a collection of methods will be required to achieve decontamination goals after high concentration exposures.

Different techniques may be more appropriate after low concentration exposure. Careful integration of several technologies can provide superior, cost-effective protection for the warfighter.



Self-Decontaminating CARC Technology

- **Friendly:** A thin topcoat or a component in an existing coating
- **Hardy:** Able to survive macro decontamination processes
- **Continuous:** Handles fugitive emissions.
- **Enabling:** Allows for less than perfect execution of macro methods
- **Photoenergetic:** Some mechanisms use room light



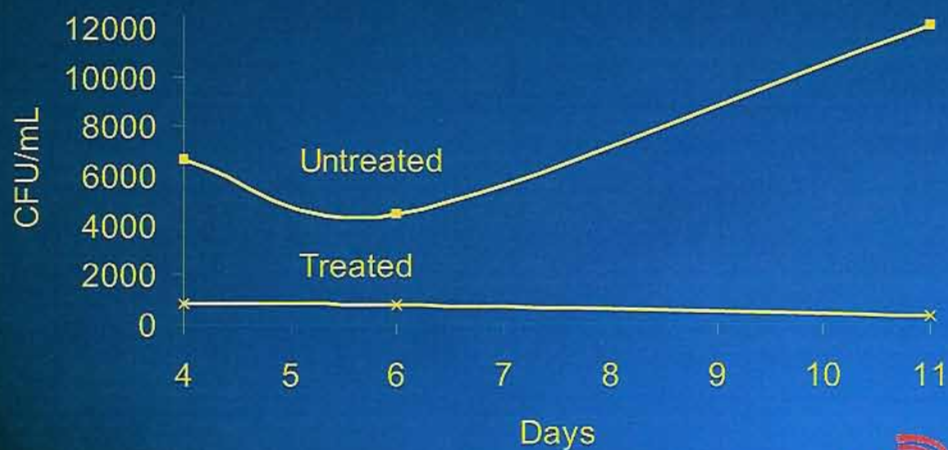


Previous Decontamination Research

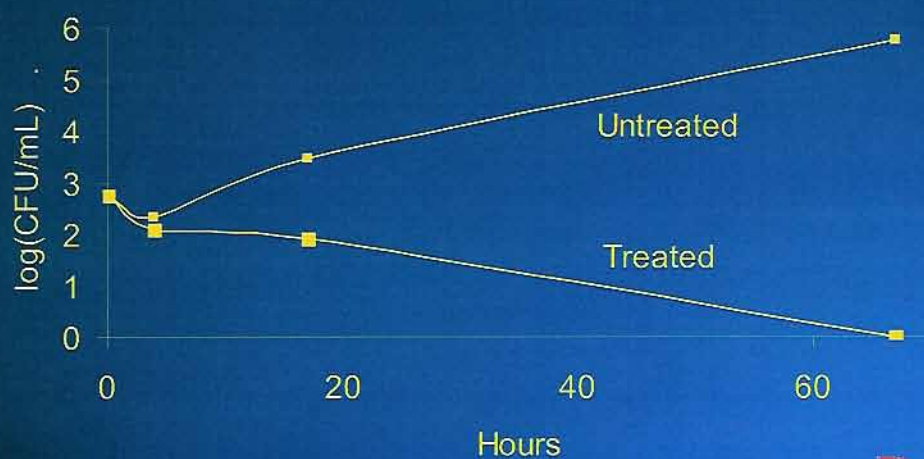
- **Surrogate CW agents:** Phosphite (25%/min) and sulfide (50%/hr) decontamination of air in the active zone
- **Bacteria:** Continuous disinfection of low-level bacterial contamination
- **Biofilm:** Inhibition of biofilm formation even in the dark
- **Dehalogenation:** Surface chemistry



Biofilm Inhibition in Tubing



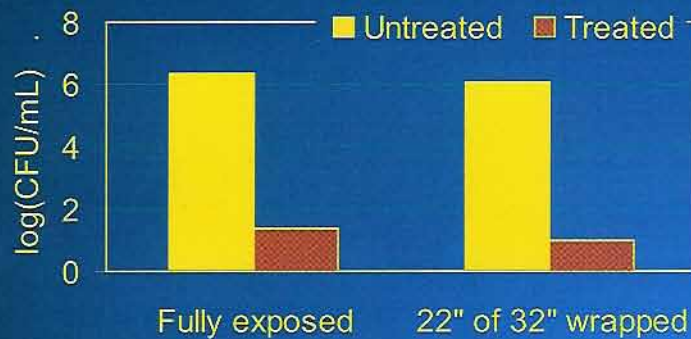
Potable Water Preservation in Tubing



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Water Polishing in Light or Dark

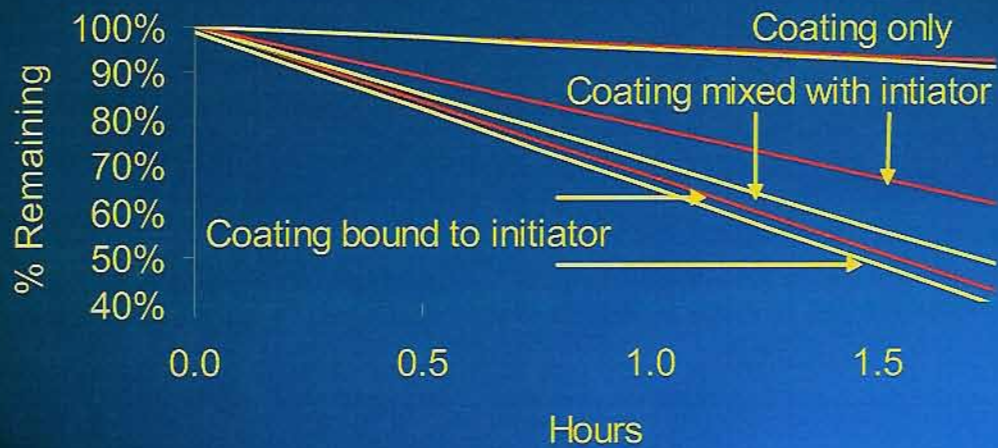
Partially Wrapped vs Unwrapped Tubing
Water Disinfection



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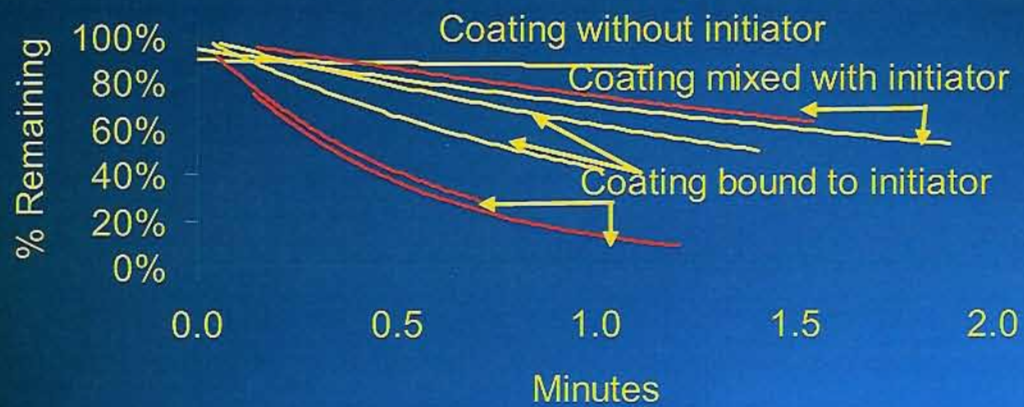
Sulfide Decomposition



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Phosphite Decomposition



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Coating Characteristics

- Thin topcoat or as a component of a CARC
- Pocket-size activity meter developed
- Vapors must be within 1 mm of surface
- Accumulated grime presents a barrier



Present Research

- Coating formulation
- Determining disinfection rate of *E. coli* on surfaces
- *Bacillus subtilis* deactivated on surface as the spore converts to the vegetative state
- *Vaccinia* investigation not yet begun
- Decomposition of surrogate CW agents being monitored by a novel sensor composed of the same coating





High Bacterial Dose on a Surface

- Starting dose: $>10^{11}$ CFU/m² (Bacteria covered ~ 10% of surface)
- Coating: 5% pigment
- Pigment: 1.6% active
- ~ 50%/hr kill rate



Low Bacterial Dose on a Surface

- Starting dose: $>10^9$ CFU/m²
- Active surface: ~ 1.6%
- Time: 7 hr
- Death by drying: 99.9%
- Blank: ~ 10^6 CFU/m²
- Sample: 0 CFU/m²





High Bacterial Dose in Water

- Starting dose: $>10^7$ CFU/mL
- Surface area: 20 cm^2
- Active surface: $\sim 1.6\%$
- Volume: 100 mL
- $T_{1/2} \sim 40$ minutes



Low Bacterial Dose in Water

- Starting dose: >1 CFU/mL
- Surface area: 20 cm^2
- Active surface: $\sim 1.6\%$
- Volume: 100 mL
- Time: 24 hr
- Blank final value: $>10^7$ CFU/mL
- Sample final value: 0 CFU/mL





Distance Disinfection

- A damp 125 μm cellulose nitrate membrane with 0.45 μm pores on which were deposited ~ 100 *E. coli* was placed on an illuminated activated surface with the bacteria away from the surface.
- Approximately 6% of the incident light reached the 1.6% active surface.
- The death rate of the *E. coli* was $\sim 70\%/hr$.



Spore Control

- Dry spores were essentially unaffected on the activated surface.
- In the presence of moisture, the spores break open to produce vegetative cells.
- The activated surface killed many emerging cells:
 - First stimulation: $\sim 90\%$ kill
 - Second stimulation: ~ 4 -log kill





Applications

- Continuous disinfection in clean areas
- Elimination of fugitive emissions above sensitive electronics
- Polishing/preserving potable water
- Polishing/preserving equipment after macro decontamination
- Smart CW sensor formed from the same activated polymer



Questions

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